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Updating the Godiva-IV Benchmark

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Summer Fun – Camping in Moab, Utah



Victoria Hagopian (Group NEN-2)

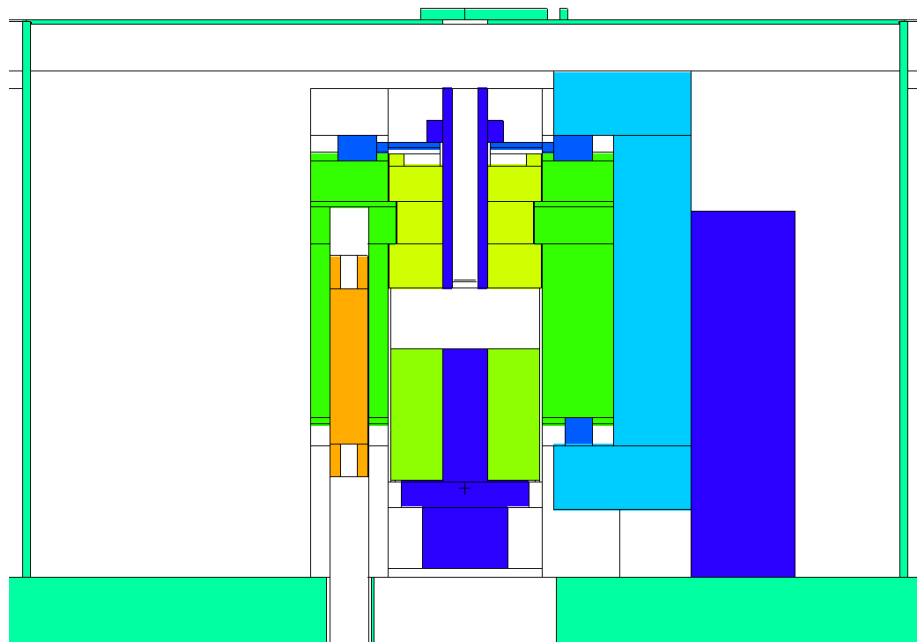
- Educational Background
 - BS North Carolina State University, 2017
 - PhD Penn State University, 2022
- Division
 - Group: NEN-2
 - Mentors: Joetta Goda, Jesson Hutchinson, Geordie McKenzie
- Research
 - Updating Godiva-IV benchmark
 - Critical and subcritical experiments



PennState



Research Overview and Motivation



- **From the disassembly...**
 - Updated spindle dimensions
 - Updated glory-hole dimensions
 - Addition of shim
- **New top hat**
- **New cross-section libraries**
 - Comparison between ENDF/B-VII.1 and ENDF/B-VIII.0
- **TR Cards**

Research Approach

```
365 c ~~~~~ Translation Cards ~~~~~
366 c To move the Safety Block to one of the Control System positions, change the z value of TR1 to a value of the line:
367 c     y = -2.54*x-0.4207
368 c Where y is the z value in TR1 in MCNP and x is the Control System Position in inches.
369 c Equation is bounded between -0.150 and 7.844 inches.
370 TR1 0 0 0
371 c
372 c To move Control Rod 1 to one of the Control System positions, change the z value of TR2 to a value of the line:
373 c     y = -2.54*x+0.8204
374 c Where y is the z value in TR2 in MCNP and x is the Control System Position in inches.
375 c Equation is bounded between -0.160 and 4.000 inches.
376 TR2 0 0 0
377 c
378 c To move Control Rod 2 to one of the Control System positions, change the z value of TR3 to a value of the line:
379 c     y = -2.54*x+0.3175
380 c Where y is the z value in TR3 in MCNP and x is the Control System Position in inches.
381 c Equation is bounded between -0.250 and 4.000 inches.
382 TR3 0 0 0
383 c
384 c To move the Burst Rod to one of the Control System positions, change the z value of TR4 to:
385 c
386 c Control System Position | z Value of TR4
387 c     Full-In           |      7.51050
388 c     Full-Out          |      0.00000
389 TR4 0 0 0
390 c
```

Summary of Results – ENDF/B-VII.1 vs ENDF/B-VIII.0

ENDF/B-VII.1 Cross Section Results

Case: Top Hat	Present	Removed
k_{eff}	0.99810 ± 0.00027	0.99710 ± 0.00026
Average Energy of Neutrons Causing Fission (MeV)	1.4251	1.4268
Average Number of Neutrons Produced per Fission ($\bar{\nu}$)	2.595	2.595
Percentage of Fission Caused by Neutrons		
Thermal(< 0. 625 eV)	0.00%	0.00%
Intermediate (0. 625 eV – 100 keV)	5.54%	5.50%
Fast (> 100 keV)	94.46%	94.50%

ENDF/B-VIII.0 Cross Section Results

Case: Top Hat	Present	Removed
k_{eff}	0.99773 ± 0.00028	0.99633 ± 0.00026
Average Energy of Neutrons Causing Fission (MeV)	1.4227	1.4243
Average Number of Neutrons Produced per Fission ($\bar{\nu}$)	2.592	2.592
Percentage of Fission Caused by Neutrons		
Thermal(< 0. 625 eV)	0.00%	0.00%
Intermediate (0. 625 eV – 100 keV)	5.04%	5.01%
Fast (> 100 keV)	94.96%	94.99%

Summary of Results – Benchmark Case 4

Benchmark Case 4 Results

Model:	Case 4
k_{eff} - ENDF/B-VI	0.9897 ± 0.0003
k_{eff} - ENDF/B-VII.1	0.9907 ± 0.0003
Average Number of Neutrons Produced per Fission ($\bar{\nu}$)	2.593
Percentage of Fission Caused by Neutrons	
Thermal(< 0.625 eV)	0.00%
Intermediate (0.625 eV – 100 keV)	5.57%
Fast (> 100 keV)	94.43%

